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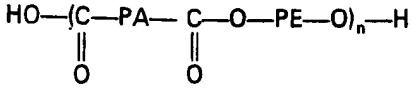
(71) Applicant
Malcolm Thomas Craig,
32 Central Avenue,
Pinnar, Middlesex
HA5 5BS
(72) Inventor
Malcolm Thomas Craig
(74) Agent and/or Address for Service
J. Y. and G. W. Johnson,
Furnival House, 14—18
High Holborn, London
WC1V 6DE

(54) Apparatus for, and method of, improving a plant growing environment

(57) The invention relates to a method of improving the growing environment of plants in a plant growth enclosure which comprises positioning in the enclosure a liquid-filled flexible container made of a liquid-transpirable material of the general formula



where PA is a rigid polyamide segment (preferably nylon 6) and PE is a flexible polyether segment. Suitably the liquid is an aqueous solution of a plant growth influencing substance.

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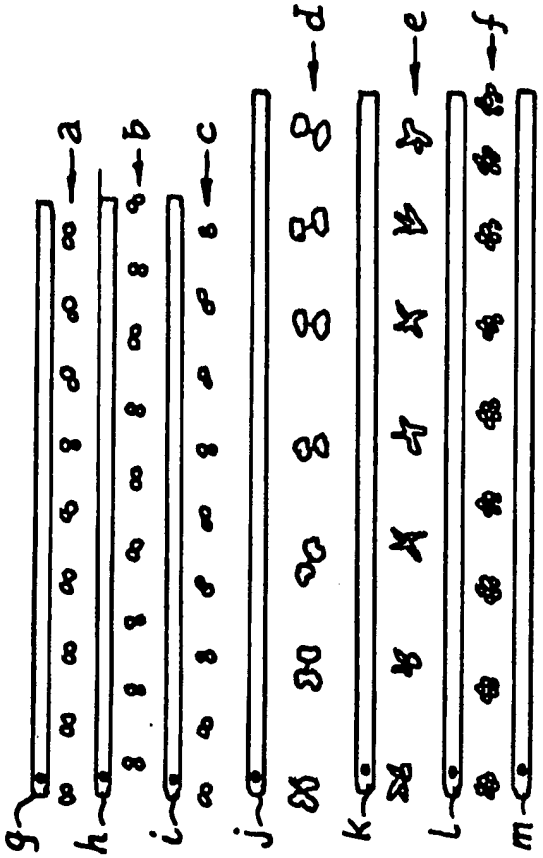


FIG. 1

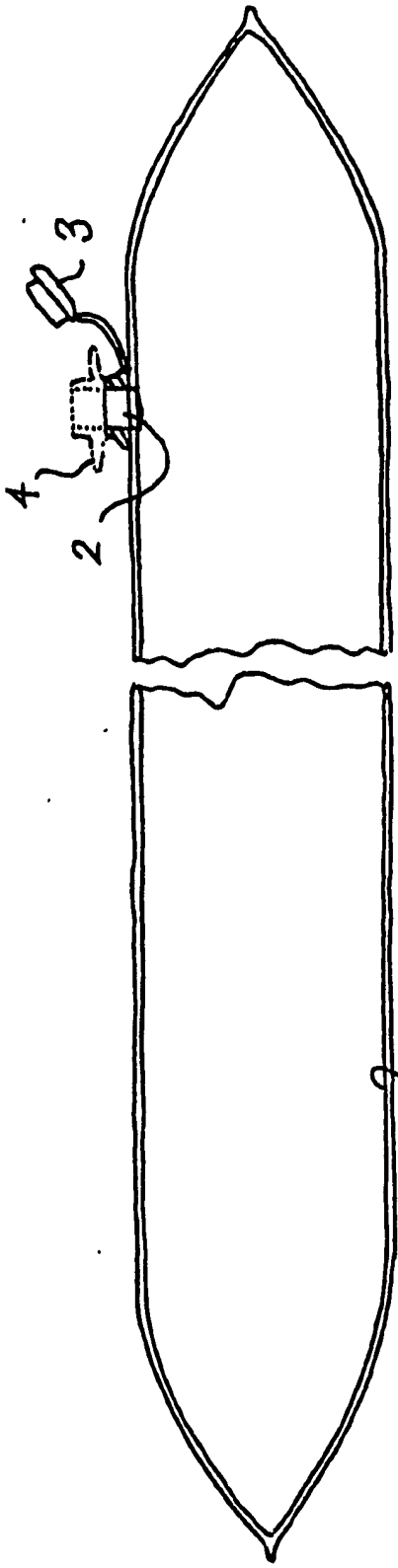


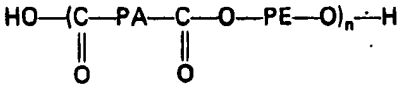
FIG. 2

SPECIFICATION

Apparatus for, and method of, improving a plant growing environment

This invention relates to a method of, and apparatus for, improving the growing environment of plants or seeds in a plant growth enclosure, such as a glasshouse, greenhouse or cloche.

According to one aspect of the invention a method of improving the growing environment of plants or seeds in a plant growth enclosure comprises positioning in the enclosure a liquid-filled flexible container whose wall(s) is (are) made of a material of the general formula



where PA is a rigid polyamide segment and PE is a flexible polyether segment, the container serving to transpire liquid from within to the environment of the plants or seeds.

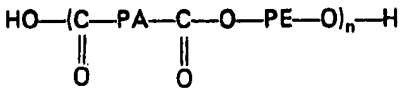
The container may be elongate and have a filled volume in the range of from 10 to 3000 cc/cm length, preferably in the range 20 to 100 cc/cm length; a filled volume of around 30 cc/cm length being particularly convenient.

Conveniently the wall material of the container is dark coloured to enhance the absorption of radiant energy by the container and the radiation of absorbed heat to the plants or a seed bed in the enclosure. A length of dull black lay-flat polyether block amide tubing of 500 to 1000 gauge welded at its ends and provided with a closable valve is a particularly suitable container for use in the method of the invention. The closable valve desirably is provided with a flange which can be used as a finger support to permit the valve to be closed without increasing the hydraulic pressure within the filled container.

Suitably the liquid within the container is intended to nourish the plants or plants growing from the seeds. The liquid can contain additives for fungal or pest control.

Desirably the PA segment of the wall material is nylon 6. Suitably the wall material can absorb at least its own weight of water when fully saturated.

According to a further aspect of the invention a plant growth improving apparatus comprises a flexible bladder of a liquid-transpirable material of the general formula



where PA is a rigid polyamide segment and PE is a flexible polyether segment and means to close the bladder around a volume of liquid which can enhance plant growth.

The wall thickness of the bladder would normally be less than 0.060" and preferably in the range of 0.004" to 0.010".

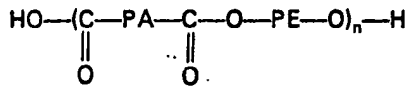
The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 shows a plan of rows of plants whose growing environment has been improved by the method of the invention, and

Figure 2 is a sectional enlarged view of one of the tubular containers shown in Figure 1.

Figure 1 shows a bed of plant growing medium in a plant growth enclosure (not shown) having rows of plants *a* to *f* with tubular containers *g* to *m* located on each side of each row. The containers *g* to *m* can be of any convenient length and one such container is shown in greater detail in Figure 2.

Figure 2 shows an elongate, flexible, dark-coloured, tubular container 1 made of a material having the general formula



where PA is a rigid polyamide segment (preferably nylon 6) and PE is a flexible polyether segment. A preferred polyether block amide (PEBA) is that known under the Trade Mark PEBAX with the grade designation "4011 RN 00" and obtainable from ATO Chemical Products (UK) Ltd. of Newbury, Berkshire. This material has a density of 1.14, a melt point of 190°C and a melt flow index of 10 at 235°C/1 kg and can absorb more than 100% its own weight of water when fully saturated and transpires water (with or without chemical additives) at a substantial rate under normal ambient temperature and humidity conditions. Typical wall thicknesses for the PEBA film would be between 0.004" and 0.010".

The container 1 is sealed, e.g. seam welded, at both ends and is filled, through a closable valve 2 having a closure cap 3, with liquid, e.g. water or an aqueous solution of a plant-growth influencing material (e.g. a fertiliser, pesticide and/or a fungicide). The closable valve 2 may be provided with a flange 4 (shown in dotted lines in Figure 1) which is spaced from the walls of the container 1 a sufficient distance to enable a user's fingers to be positioned therebetween; the flange 4 thus acting as a finger support which enables the valve 2 to be closed by the cap 3 without increasing the hydraulic pressure within the container 1. Conveniently the closable valve 2 is designed to be suitable for connection directly, or via a connector (not shown) to a standard hosepipe (not shown).

The elongate containers *g* to *m* act as heat storage devices during the day, absorbing and storing any radiant thermal energy, in particular solar energy falling on them. During the night, when the temperature in the enclosure falls below that of the liquid in the containers, each container radiates heat to the adjacent row or rows of plants. In addition to supplying heat to the rows of plants, the elongate containers also act as humidifiers of the enclosure which, by virtue of their moisture transmission rate, supply liquid

vapour to the surrounding atmosphere whenever the relative humidity of the latter falls below a certain value. By filling the containers (or some of them) with appropriate solutions, the surrounding atmosphere and plants will absorb warm, moist vapour from the containers which contain plant nutrients and/or fungicides and/or pesticides. It should also be realised that the positioning of the containers on each side of each row of plants, serves to reduce weed growth.

The opaque nature of the container wall also serves to prevent fungal growth within the filling liquid.

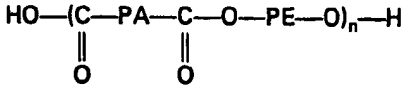
In order to obtain effective heat absorbing and heat radiating capabilities, each container has to have a filled volume which is at least 10 cc/cm length and no more than around 300 cc/cm length. Preferably the filled volume of each container is in the range of from 20 to 200 cc/cm length and ideally from 20 to 100 cc/cm length. A particularly advantageous embodiment of container has a circular cylindrical form when filled with liquid with a diameter of 6.35 cm (i.e. a volume of some 31.5 cc/cm). The containers may be supplied in different lengths and typically each container has a length of from 1 to 4 m, e.g. around 2.5 m.

An elongate tubular container is particularly convenient for rows of plants, but the invention is not limited to bladders of that shape.

It will be appreciated that in practice it is not an easy matter to completely fill a flexible container with liquid and that a small proportion of residual air in the container(s) disclosed herein will not significantly affect its (their) performance as a liquid supply source or as a heat store. Thus it should be understood that the references to a "liquid filled container" or "filled with liquid" in the following claims should be taken to mean substantially filled, although the references to "filled volume", when designating the cross-sectional area of a container, can be taken to mean the volume when completely filled.

CLAIMS

1. A method of improving the growing environment of plants or seeds in a plant growth enclosure, which comprises positioning in the enclosure a liquid-filled flexible container whose wall(s) is (are) made of a material of the general formula



where PA is a rigid polyamide segment and PE is a flexible polyether segment, the container serving to transpire liquid from within to the environment of the plants or seeds.

2. A method as claimed in claim 1, in which the liquid within the container is intended to nourish the plants, or plants growing from the seeds.

3. A method as claimed in claim 1 or claim 2, in which the liquid within the container is a pesticide or fungicide.

4. A method as claimed in any preceding claim, in which the wall material is dark-coloured to enhance the absorption of radiant energy by the container and the radiation of absorbed heat to the plants or a seed bed in the enclosure.

5. A method as claimed in any preceding claim, in which the container is elongate and has a filled volume in the range of from 10 to 300 cc/cm length.

6. A method as claimed in claim 5, in which the container has a filled volume in the range 20 to 100 cc/mm length.

7. A method as claimed in claim 5 or claim 6, in which the container has a length of between one and four metres.

8. A method as claimed in any of claims 5 to 7, in which the container is formed from a length of lay-flat tubing sealed at its ends and provided with a closable valve by which it was filled with liquid.

9. A method as claimed in any preceding claim, in which the PA segment of the wall material is nylon 6.

10. A method as claimed in any preceding claim, in which the wall material can absorb at least its own weight of water when fully saturated.

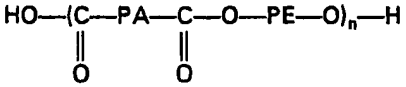
11. A method as claimed in any preceding claim, in which the wall thickness of the container is less than 0.060".

12. A method as claimed in claim 11, in which the wall thickness of the container is in the range 0.004" to 0.010".

13. A method as claimed in any preceding claim in which the enclosure is a glasshouse or greenhouse.

14. A method as claimed in any of claims 1 to 12, in which the enclosure is formed against the upper surface of a bed of plant growing medium by a sheet of light permeable plastic material.

15. Plant growth improving apparatus comprising a flexible bladder of a liquid-transpirable material of the general formula



where PA is a rigid polyamide segment and PE is a flexible polyether segment and means to close the bladder around a volume of liquid which can enhance plant growth.

16. The apparatus of claim 15, in which the material can absorb at least 100% of its own weight of water when fully saturated.

17. The apparatus of claim 15 or 16, in which the PA segment is nylon 6.

18. The apparatus of any of claims 15 to 17, in which the bladder has a wall thickness between 0.004" and 0.010".

19. The apparatus of any of claims 15 to 18, in which the bladder closing means is a closable valve provided with a flange which can be used as a finger support to permit the valve to be closed

without increasing the hydraulic pressure within the bladder.

20. The apparatus of any of claims 15 to 19, in which the liquid within the bladder is water containing an additive for plant nourishment or fungal or pest control.

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